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(54) [Title of Invention] IMAGE PICKUP DEVICE AND ITS METHOD

(57) [ABSTRACTS]

[PROBLEM TO BE SOLVED] To change a photographing method and an image data storing method according to a photographing mode.

[SOLUTION] when a photographing mode previously set by a user is

a 'sport mode' at S107, normal photographing and reversible compression are executed at S109. On the other hand, at the time of a 'portrait mode', highly detailed photographing and irreversible compression are executed by a 'photographing and recording mode 2' at S111.

[CLAIMS]

[claim 1]

An image pickup device, comprising:

image pickup means for focusing a subject image and creating an image signal by photoelectric conversion;

pixel shifting means for shifting a position of said subject image focused on said image pickup means in parallel for a certain distance;

composing means for composing image data of a plurality of frames obtained by said image pickup means every plurality of movements by said pixel shifting means;

format conversion means for converting said image data composed by said composing means into a certain format;

holding means for holding said image data converted into said certain format by said format conversion means;

setting means for setting a photographing mode of an image pickup device; and

control means for controlling an image composition by said image composing means depending on said photographing mode.

[Claim 2]

The image pickup device as recited in claim 1, wherein said

control means controls whether or not image composing by said image composing means is performed depending on said photographing mode.

[Claim 3]

The image pickup device as recited in claim 2, wherein said control means further controls a conversion method in said format conversion means depending on said photographing mode.

[Claim 4]

The image pickup device as recited in claim 3, wherein said format conversion means compresses image data.

[Claim 5]

The image pickup device as recited in claim 4, wherein, when said photographing mode is a first mode, said control means controls such that an image composition in said image composing means is not performed, and when said photographing mode is a second mode, said control means controls such that an image composition in said image composing means is performed so as to perform a compression at compression rate higher than in said first mode.

[Claim 6]

The image pickup device as recited in claim 1, wherein said setting means arbitrarily sets a photographing mode corresponding to a state of a subject.

[Claim 7]

The image pickup device as recited in claim 1, further comprising hand-blurring correction means for correcting an influence caused by blurring of said image pickup device at the time of photographing, wherein said pixel shifting means performs

pixel shifting by said hand-blurring correction means.

[Claim 8]

An image pickup device, comprising:

image pickup means for focusing a subject image and creating an image signal by photoelectric conversion;

pixel shifting means for shifting a position of said subject image focused on said image pickup means in parallel for a certain distance;

composing means for composing image data of a plurality of frames obtained by said image pickup means every plurality of movements by said pixel shifting means;

format conversion means for converting said image data composed by said composing means into a certain format;

holding means for holding said image data converted into said certain format by said format conversion means;

detecting means for detecting a photographing state of an image pickup device; and

control means for controlling an image composition by said image composing means depending on said photographing state.

[Claim 9]

The image pickup device as recited in claim 8, wherein said control means controls whether or not an image composition in said image composing means is performed depending on said photographing state.

[Claim 10]

The image pickup device as recited in claim 9, wherein said

detecting means detects a blur-degree of a whole image pickup device at the time of photographing.

[Claim 11]

The image pickup device as recited in claim 10, wherein said control means controls such that said image composition in said image composing means is not performed when said blur-degree is more than a predetermined value and that said image composition in said image composing means is performed when said blur-degree is less than said predetermined value.

[Claim 12]

The image pickup device as recited in claim 11, wherein said control means controls a conversion method in said format conversion means depending on said blur-degree.

[Claim 13]

The image pickup device as recited in claim 12, wherein said format conversion means compresses image data.

[Claim 14]

The image pickup device as recited in claim 8, further comprising hand-blurring correction means for correcting influence due to said hand-blurring at the time of photographing, wherein said pixel shifting means performs said pixel shifting by said hand-blurring correction means.

[Claim 15]

An image pickup device, comprising:

image pickup means for focusing a subject image and creating an image signal by photoelectric conversion;

pixel shifting means for shifting a position of said subject image focused on said image pickup means in parallel for a certain distance;

composing means for composing image data of a plurality of frames obtained by said image pickup means every plurality of movements by said pixel shifting means;

format conversion means for converting said image data composed by said composing means into a certain format;

holding means for holding said image data converted into said certain format by said format conversion means; and

control means for controlling an image composition by said image composing means depending on a holding situation of an image data in said holding means.

[Claim 16]

The image pickup device as recited in claim 15, wherein said control means controls whether or not an image composition in said image composing means is performed depending on the holding situation of said image data in said holding means.

[Claim 17]

The image pickup device as recited in claim 16, wherein said control means controls whether or not said image composition by said image composing means is performed depending on unused capacity of said holding means.

[Claim 18]

The image pickup device as recited in claim 17, wherein said control means controls such that said image composition in said

image composing means is not performed when said unused capacity of said holding means is less than a predetermined value and that said image composition in said image composing means is performed when said unused capacity of said holding means is a predetermined value or more.

[Claim 19]

The image pickup device as recited in claim 18, wherein said control means controls a conversion method in said format conversion means depending on said unused capacity of said holding means.

[Claim 20]

The image pickup device as recited in claim 19, wherein said format conversion means compresses image data.

[Claim 21]

The image pickup device as recited in claim 20, wherein said control means controls such that said compression is performed at a compression rate higher than that in cases where said unused capacity in said format conversion means is a certain value or more when said unused capacity of said holding means is less than a certain value.

[Claim 22]

The image pickup device as recited in claim 15, further comprising hand-blurring correction means for correcting influence due to said hand-blurring at the time of photographing, wherein said pixel shifting means performs said pixel shifting by said hand-blurring correction means.

[Claim 23]

An image pickup method for use in an image pickup device which focuses a subject image on image pickup means and creates an image signal by photoelectrical conversion, said method comprising:

a mode setting step for setting a photographing mode by a user;

a photographing instruction step in which a user instructs a photographing start by said image pickup device;

a normal photographing step for obtaining an image data of a single frame by said image pickup means when a first mode is set in said mode setting step;

a first conversion step for converting an image data obtained in said normal photographing step into a first format;

a pixel shifting photographing step for obtaining image data of a plurality of frames by shifting a position of a subject image focused on said image pickup means in parallel for a certain amount when a second mode is set in said mode setting step;

a composing step for composing image data of a plurality of frames obtained in said pixel shifting step;

a second conversion step for converting image data composed in said composing step into a second format; and

a saving step for saving image data converted into said first and second formats into storing means.

[Claim 24]

The image pickup method as recited in claim 23, wherein image data is compressed into said first format in said first conversion

step, and wherein image date is compressed into a second format at a compressing rate higher than a compressing rate of said first format.

[Claim 25]

The image pickup method as recited in claim 24, further comprising the steps of a blur-detecting step for detecting a blur-degree of an image pickup device, wherein said image date composition in said composing step is not performed when said blur-degree exceeds a predetermined value.

[Claim 26]

The image pickup method as recited in claim 25, further comprising a capacity detection step for detecting unused capacity of said storing means, wherein photographing by said normal photographing step is performed when said unused capacity of said storing means is less than a predetermined value, and wherein image data obtained at said normal photographing step is converted into said second format at said second conversion step.

[Claim 27]

A computer readable memory that stores program codes on a photographing method in an image pickup device for focusing a subject on image pickup means and creating image signal by photoelectric conversion, the memory comprising:

a mode setting step code by which a user sets a photographing mode;

a photographing instruction step code by which a user instructs a photographing start;

a normal photographing step code by which image data of one frame is obtained when a first mode is set at said mode setting step;

a first conversion step code for converting image data obtained at said normal photographing step into a first format;

a pixel shifting photographing step code for obtaining image data of a plurality of frames by shifting the position of subject focused on said image pickup means in parallel for a certain distance when a second mode is set at said mode setting step;

a composition step code for composing image data of a plurality of frames obtained at said pixel shifting step;

a second conversion step code for converting image data composed at said composing step into a second format; and

a storing step code for storing image data converted into said first and second format into storing means.

[Detail description of the invention]

[0001]

[Technical field of the invention] The present invention relates to an image pickup device and an image pickup method, and more particularly to, an image pickup device and an image pickup method which store photographic images as electric signals into the device.

[0002]

[Prior Art]

In accordance with development of the recent image processing technology, an image pickup device such as a digital still camera

employing the aforementioned technology has been remarkably developed.

[0003]

Here, a structure of a conventional digital still camera is shown in Fig. 18, and the operation thereof will be explained briefly.

[0004]

In the figure, the reference numeral 91 denotes a camera operation switch including a main switch and a release switch of the camera. Although the camera operation switch 91 is operated by a user, the operational change is detected by a general controller 80 to start to supply electric power to each another block.

[0005]

The subject within the photographing frame area is focused on an image pickup portion 82 through a main photographic optical system 81. The electrical signal from the image pickup portion 82 is converted sequentially into prescribed digital signals for every each pixel via an A/D converter 83, and then inputted into a process processor 84. In the process processor 84, each color signal of RGB is created based on each pixel data from the image pickup portion 82. Before a normal photographing, each color signal is periodically transferred (for every flame) to a video memory 89 via a memory controller 85 to perform a finder display or the like via a monitor display portion 90.

[0006]

Furthermore, in cases where a user performed a photographing

operation by manipulating the camera operation switch 91, each pixel data of one frame from the process processor 84 is stored in a frame memory 86 based on a control signal from the general controller 80. Thereafter, the data in the frame memory 86 is compressed based on a prescribed compression format by the memory controller 85 and a work memory 87, and the result is stored in an external memory 88 constituted by a non-volatile memory such as a flush memory. In the meantime, in accordance with the recent development of image pickup device developing technique, although cameras that can selectively obtain a normal image data and more detail image data are available, these detail image data is also compressed by a prescribed format and stored in the external memory 88 as in the same manner mentioned above.

[0007]

Furthermore, in cases where a user observes the photographed image data, the data compressed and stored in the external memory 88 is expanded into a normal photographic pixel data by the memory control portion 85, and the result is transferred to the video memory 89. This enables an observation of the image via the monitor display means 90.

[0008]

As explained above, in conventional digital still cameras, in cases where the photographed image data is stored in a memory or the like, the data will be stored at a prescribed specific compression format or a compression rate irrespective of the photographing conditions and/or the photographing scene.

Alternatively, the data will be compressed by the compression method and at the compression rate set by a user.

[0009]

[Problems to be solved by the invention]

However, in the aforementioned conventional digital still camera, the saving of the photographed image data is performed impartially at the camera side irrespective of the contents of the photographed image. Therefore, the photographed image data is not necessarily saved in the most suitable state (compression form). This will be also applied to the case where photographing for obtaining the aforementioned detail image data is performed, in other words, in the case where the image data amount is large.

[0010]

Furthermore, even in cases where a user can set the saving method of the photographed image, it is also very troublesome to appropriately set the image compression method depending on the photographed image every photographing. Accordingly, it becomes difficult to perform a quick photographing operation, resulting in a missing of good photographing opportunity. Furthermore, in cases where the setting of a saving method of the photographed image is performed simultaneously with the setting of the photographing method of image, these operations become further difficult unless the user is well skilled.

[0011]

The present invention has made to solve the aforementioned problems, i.e., problems that setting a photographing method of

an image and a saving method of image data is troublesome. The first object of the present invention is to provide an image pickup device and an image pickup method that can change a photographing method and an image data saving method depending on a photographing mode.

[0012]

Furthermore, the second object of the present invention is to provide an image pickup device and an image pickup method that can change a photographing method and an image data saving method depending on a status of a device at the time of photographing.

[0013]

Furthermore, the third object of the present invention is to provide an image pickup device and an image pickup method that can change a photographing method and an image data saving method depending on a data-saving-status to a memory or the like.

[0014]

[Means for solving problems]

As one of means for attaining the aforementioned objects, the image pickup device according to the present invention is equipped with the following structure.

[0015]

That is, the image pickup device includes image pickup means for focusing a subject image and creating an image signal by photoelectric conversion, pixel shifting means for shifting a position of the subject image focused on the image pickup means in parallel for a certain distance, composing means for composing image data of a plurality of frames obtained by the image pickup

means every plurality of movements by the pixel shifting means, format conversion means for converting the image data composed by the composing means into a certain format, holding means for holding the image data converted into the certain format by the format conversion means, setting means for setting a photographing mode of an image pickup device, and control means for controlling an image composition by the image composing means depending on the photographing mode.

[0016]

For example, the aforementioned control means controls whether or not image composing by the image composing means is performed depending on the photographing mode.

[0017]

Furthermore, the control means controls a conversion method in the format conversion means depending on the photographing mode.

[0018]

For example, the format conversion means compresses image data.

[0019]

For example, when the photographing mode is in a first mode, the control means controls such that an image composition in the image composing means is not performed. And, when the photographing mode is in a second mode, the control means controls such that an image composition in said image composing means is not performed, and when the photographing mode is a second mode, the control means controls such that an image composition in the

image composing means is performed so as to perform a compression at compression rate higher than in the first mode.

[0020]

An image pickup device comprises image pickup means for focusing a subject image and creating an image signal by photoelectric conversion, pixel shifting means for shifting a position of the subject image focused on the image pickup means in parallel to a certain distance, composing means for composing image data of a plurality of frames obtained by the image pickup means every plurality of movements by the pixel shifting means, format conversion means for converting the image data composed by the composing means into a certain format, holding means for holding the image data converted into a certain format by the format conversion means, detecting means for detecting a photographing state of an image pickup device, and control means for controlling an image composition by the image composing means depending on the photographing state.

[0021]

Furthermore, an image pickup device comprises image pickup means for focusing a subject image and creating an image signal by photoelectric conversion, pixel shifting means for shifting a position of the subject image focused on the image pickup means in parallel for a certain distance, composing means for composing image data of a plurality of frames obtained by the image pickup means every plurality of movements by the pixel shifting means, format conversion means for converting the image data composed by

the composing means into a certain format, holding means for holding the image data converted into a certain format by the format conversion means, and control means for controlling an image composition by the image composing means depending on a holding situation of an image data in the holding means.

[0022]

[Embodiments of the Invention]

Next, one embodiment of the present invention will be explained in detail with referring to drawings.

[0023]

<First embodiment>

Fig. 1 is a block diagram showing the whole structure of a digital still camera (hereinafter simply referred to as 'camera') according to an embodiment. In the figure, the reference numeral 1 denotes a general control portion including a CPU for controlling the whole camera. The reference numeral 2 denotes a photographing mode setting portion for setting a photographing mode of the camera itself. The photographing mode setting portion comprises a switch or the like by which a user can set, for example, a 'sport mode' which is the most suitable mode for photographing a moving subject and a 'portrait mode' which is the most suitable mode for photographing a stationary subject. The reference numeral 18 is a camera operation switch for instructing a start of photographing of the camera. The camera operation switch includes a main switch, a release switch, etc.

[0024]

The reference numeral 3 denotes a main photographing optical system of the camera, and 4 an optical means for spatially shifting an subject focused on an image pickup portion 6 in parallel which will be mentioned later. As the optical means 4, the so-called shift correction optical system, which is shown in Japanese Unexamined Laid-open Patent Publication H3-186823, is used. This shift correction optical system is normally used in a hand-blurring prevention mechanism of the whole camera. Furthermore, the reference numeral 17 denotes a blur sensor having two angular speed sensors, usually called as oscillating gyroscopes, which detect the blur amount of the whole camera by separately detecting different angular blurring about two axes. In the camera according to this embodiment, the output of the blur sensor 17 is converted into data for driving the shift correction optical system 4 in the general control portion 1, and the lens in the shift correction optical system 4 is driven via the lens-driving portion 5. This can stabilize the subject image focused on the focusing face without causing any blurring even in a hand-held operation.

[0025]

The signal of the subject image focused on the image pickup portion 6 is subjected to a series of the below-mentioned image signal processing based on the control of the general control portion 1 in each structure until it is displayed on the monitor display portion 16, and then converted into a prescribed digital data.

[0026]

First, the electric charges accumulated for a predetermined time (corresponding to the subject image) are sequentially read out for every pixel at the image pickup portion 6 including CCD and the like. At the same time, the subject intensity information corresponding to the amount of electric charges is converted into digital data at the A/D converter 7. On the image pickup portion 6, an optical color filter for creating each of color signals such as RGB signals is adhered. Accordingly, the output signal from the image pickup portion 6 becomes a signal showing each of RGB colors by turn.

[0027]

At the actual stage before photographing, the output value from the A/D converter 7 is inputted into the process processing circuit 8 to be subjected to dark level correction or γ-conversion, and then inputted into the image-composing portion 9.

[0028]

Next, the image processing at the image-composing portion 9 will be explained with reference to Fig. 2.

[0029]

In the image-composing portion 9, RGB data of each pixel are composed by using different interpolation filters of Green (G), and Red (R)/Blue (B) for the array of an optical filter as shown in Fig. 2. The array of this optical filter is a general Bayer array, and G and R/B are different in array, i.e., G is a checker array and R/B is a line sequential array. In general, in cases where an image pickup element constituting the image pickup portion 6 is

made of a single plate, the image pickup element has an array as shown in the left side of Fig. 2. Accordingly, since all of the pixels of the image data inputted from the image pickup element do not always include all of color information, at the image-composing portion 9, RGB color information of all of the pixel points on the image pickup element is created by an interpolation filter operation using 3 x 3 matrix as shown in the center of Fig. 2.

[0030]

Now, how to create G data of the pixel a in the pixel array of the image pickup element shown in the left side of Fig. 2 will be explained. In this case, the G data in the pixel a can be obtained by multiplying each coefficient of the interpolation filter for G by each intensity data of the pixel a and its peripheral eight pixels. In Fig. 2, the coefficient against the G output at the position of the pixel a is '1,' the coefficient at the upper, lower, left and right positions of the pixel a is '0.25,' respectively, and the coefficient at the right upper, right lower, left upper and left lower positions of the pixel a is '0,' respectively. Accordingly, in this case, the G data can be substantially determined only by the output value at the position of this pixel a.

[0031]

On the other hand, in cases where the G data in the pixel b is created, similarly, the G data can be obtained by multiplying the coefficient of the interpolation filter for G by each intensity data of the pixel b and its peripheral eight pixels. In this case,

since the G output of the pixel b is '0,' the G data of the pixel b can be determined from the G output average of four pixels, or the upper, lower, left and right pixels.

[0032]

Regarding the interpolation filter for R/B, in the same way as mentioned above, the R/B data against all of the pixel points can be determined (the format of the interpolation filter differs as shown in Fig .2). Thus, the output data of each color of RGB against all pixel points can be formed finally as shown in the right side of Fig. 2.

[0033]

Each data of RGB calculated in the image-composing portion 9 as explained above is transferred to a video memory 15 every frame, and a finder display of the photographed frame is carried out by the monitor display portion 16.

[0034]

The above explanation is directed to the image processing before photographing. Next, the image processing at the time of actual photographing will be explained.

[0035]

At the time of actual photographing, first, each output from the process-processing circuit 8 is directly transferred to the frame memory portion 11 having frame memories 1-N, and all frame data is stored once. Subsequently, in the image-composing portion 9, the contents of this frame memory 11 is composed by the aforementioned method, and the outputted RGB data of each pixel

is transferred to the work memory 13. Furthermore, in the memory control portion 10, the contents of the work memory 13 is compressed based on the prescribed compression format, and the result is stored in the external memory 14 comprising a non-volatile memory such as a flash memory.

[0036]

Next, observing photographed images by a user will be explained. The image data stored in the external memory 14 is once transferred to a memory control portion 10 to be subjected to an expansion processing corresponding to a prescribed compressed format. Thereafter, the result is transferred to the work memory 13. Furthermore, the date on the work memory 13 is transferred to a video memory 15 via the image-composing portion 9. This enables a display of the photographed image on the finder or the like via the monitor display portion 16.

[0037]

Next, the photographing sequence of the camera according to this embodiment will be explained briefly with referring to the flow chart of Fig. 3. The following photographing sequence is controlled by the general control portion 1.

[0038]

In the first step S100, it is discriminated whether or not the main switch (main SW) in the camera operation switch 18 is 'on.' When the main SW is tuned on by the user's operation, the routine proceeds to the step S101 immediately, and the electric power is supplied to the whole system of the camera shown in Fig. 1.

Subsequently, in S102, the blur sensor 17 is activated to start to detect the hand-blur amount of the whole camera caused by a user. Then, as detailed in S103, the shift correction optical system 4 is driven via the lens-driving portion 5 to start the actual blur correction.

[0039]

Next, in S104, as mentioned above, the signal from the image pickup portion 6 is converted into a video signal via the A/D converter 7, the process processor 8 and the image-composing portion 9. Then, in step S105, the monitor display of the video signal starts. Accordingly, after these steps S104 and S105, the aforementioned video signal processing operation will be repeated for every frame. After the aforementioned operation, in S106, in order to discriminate whether or not the release operation is performed by a user, it is detected whether the release switch (release SW) in the camera operation switch 18 is 'on.' When the switch is 'on,' the photographing operation starts immediately.

[0040]

In this embodiment, when the actual photographing operation is started, first, the photographing setting mode of the camera is judged in step S107. In the camera according to the embodiment, a user sets the so-called 'sport mode' for mainly projecting a moving subject or the so-called 'portrait mode' for mainly projecting a still subject. In Step S107, when the 'sport mode' is set, the routine proceeds to Step S108 to set a 'normal photographing mode' as a normal mode for the actual photographing. Then, in Step S109,

an actual photographing in 'photographing/storing mode 1' and storing the photographed data into the frame memory portion 11 will be performed. This operation of the aforementioned 'photographing/storing mode 1' will be detailed later.

[0041]

On the other hand, when the 'portrait mode' is set in S107, the routine proceeds to Step S110 to set the 'pixel shifting photographing mode' as a mode for the actual photographing. Then, in Step S111, the actual photographing in the 'photographing/storing mode 2' and the storing of the photographed data into the frame memory portion 11 are performed. The aforementioned 'photographing/storing mode 2' will be detailed later.

[0042]

As mentioned above, after the photographed data is stored in the frame memory portion 11 in any mode, in Step S112, it is judged whether the release SW is 'OFF.' When the release SW is 'ON,' the processing remains in Step S112 as it is. On the other hand, when 'OFF' is detected, the routine returns to Step S100.

[0043]

In this embodiment as mentioned above, depending on the set photographing mode such as the 'sport mode' or the 'portrait mode' set by a user, the actual photographing is automatically changed into the 'normal photographing' or the 'pixel shifting photographing,' and further, the saving method (compressing method) into the frame memory 11 is switched.

[0044]

Hereinafter, each operation of the aforementioned 'photographing/storing mode 1' and the 'photographing/storing mode 2' will be explained in detail.

[0045]

First, the operation of the 'photographing/storing mode 1' when the 'sport mode' is set will be explained while referring to the flowchart shown in Fig. 4.

[0046]

The output from the process processor 8 is temporarily stored into any one of frame memories in the frame memory portion 11. Then, in Step S200, '1' is set to the parameter K for selecting a frame memory, i.e., a frame memory 1 is specified. Next, in Step S201, it is discriminated whether the accumulation operation of the image data at the image pickup portion 6 has been completed, and the routine waits until the accumulation is completed. In cases where the image pickup portion 6 is constituted by a normal CCD or the like, the electric charges generated by the photoelectric-conversion operation will be immediately transferred to a transferring portion when the accumulation operation for a prescribed time has been completed. Therefore, it is assumed that the subsequent electric charge accumulation operation is being performed even in the middle of reading out the generated electric charges sequentially.

[0047]

Next, in Step S202, as mentioned above, in the process

processor 8, the process processing every each pixel data is performed, and the result is stored in the frame memory K (frame memory 1 in this case) sequentially. Then, in S203, when it is detected that all of the pixel data in one frame are stored in the frame memory K, the routine proceeds to the following step S204.

[0048]

In Step S204, the content of the frame memory K is transferred to the image-composing portion 9 to create RGB data of each pixel by the interpolation processing as mentioned above, and then the RGB data is once transferred to the work memory 13 in Step S205. This operation is continuously performed for one frame. When it is detected that one frame processing is completed in Step S206, the routine proceeds to Step S207.

[0049]

In the Step S207 to Step S211, the compression and the data storing of the actual photographed image are performed. First, in Step S207, it is set to execute a reversible compression against the memory control portion 10 as a method for compressing the actual image. As this reversible compression type, a DPCM (Differential PCM) type, which is a JPEG format defining the standard of a still image compression, or the like is used. This DPCM type is based on a concept that only the difference between the adjacent pixels among the pixels contained in the image data is coded for an electrical transmission. According to this DPCM method, although the compression rate (created image size/original size x 100) against the original image is 50% or the like, it becomes possible

to restore the original image completely from the photographed image data of any subject. Accordingly, it is preferably to use this method in cases where it is necessary to avoid a further deterioration of the original image.

[0050]

Now, a concrete example of the compression according to the DPCM method shown in Fig. 6 will be explained. In cases where the two-dimensional array of the luminance signal (or each RGB color signal) of the original image corresponds to the array shown in the upper table in Fig. 6, the array of the original image is converted into the one-dimensional array as shown in the lower table in Fig. 6. In this conversion, as shown in Fig. 6, the pixels of the original image is searched from the leftmost upper pixel of the upper row towards the rightmost upper pixel thereof in turn, and then from the rightmost pixel of the second row towards the leftmost pixel thereof. Thus, each pixel data of the original image is converted into a one-dimensional array in turn, and then the difference of the adjacent pixel data on this one-dimensional array is corded to realize the compression.

[0051]

Accordingly, in Step S208 in Fig. 4, the aforementioned reversible compression such as a DPCM is executed every block of the original image, and in Step S209, the compressed image data is converted into an actual compressed code data by utilizing Huffman-coding, etc. The aforementioned reversible compression may not always be performed every block unit. The aforementioned

Huffman-coding is a coding method enhanced in coding efficiency by assigning a longer code length to a code having a low occurrence probability and a shorter code length to a code having a high occurrence probability. Next, in Step S210, the coded image data is stored in the external memory 14 in turn, and in Step S211, after detecting that the compression and the storing into the external memory of all images (all blocks) have been completed, the processing of 'photographing/storing mode 1' is completed.

[0052]

Next, the operation of 'photographing/storing mode 2' in the 'portrait mode' will be explained.

[0053]

First, the pixel shifting photographing according to the present embodiment will be explained with reference to Fig. 7. In Fig. 7, the upper portion of Fig. 7 shows a schematic view of each RGB arrangement of the original image, the arrangement being the aforementioned Bayer arrangement. An image data horizontally shifted by one pixel pitch against the original image, which is shown in lower left portion of Fig. 7, can be obtained by shifting the correction optical portion 4 shown in Fig. 1 in the X-direction by a certain distance during the next one frame period of time. This is called 'one-time shifting.' By this one-time shifting, it is theoretically possible to double the spatial frequency of the image in the horizontal direction against each color.

[0054]

Next, while keeping the aforementioned one-time shifting,

the correction optical portion 4 is made to shift in the X-direction and Y-direction as shown in Fig. 7 by a prescribed distance. Thus, an image data shifted by a half-pixel pitch in the slant direction against the original image, which is shown in the lower central portion of Fig. 7, can be obtained. This is called 'two-time shifting.' Furthermore, while keeping the two-time shifting, the correction optical portion 4 is made to shift again only in the X-direction. Thus, an image data shifted by a half-pixel pitch in the slant direction against the original image, which is shown in the lower right portion in Fig. 7, can be obtained. This is called 'three-time shifting.'

[0055]

Thus, a total of four photographed image data shifted a prescribed pixel pitch every frame against the original image, i.e., the original image data, one-time shifted image data, two-time shifted image data and three-time shifted image data, are prepared, and then composed. This can double the spatial frequency of the image in both the horizontal and vertical directions.

[0056]

Next, the operation of the 'photographing/storing mode 2' for performing the pixel shift photographing will be explained with reference to the flowchart of Fig. 5.

[0057]

First, in Step S250, by setting '1' to the parameter K for selecting the frame memory that stores the output from the process processor 8, the frame memory 1 is specified. Then, in Step S251,

it is discriminated whether the accumulating operation of the image data has been completed in the image pickup portion 6, the routine waits until the completion of the accumulating operation.

[0058]

When the image accumulating operation of the original image as shown in Fig. 7 is completed in the image pickup portion 6, the routine proceeds to S252 and S253. In these steps, the shifted data amount $\Delta X(K)$ and $\Delta Y(K)$ of the correction optical portion 4 for realizing the first pixel shifting are set, and the correction optical portion 4 is actually shift-driven via the lens driving portion 5. In this case, the first shifted amount $\Delta X(1)$ is an amount by which the subject is shifted on the photographing surface by one pixel pitch against the original image, and the $\Delta Y(1)$ is '0' because no shifting is made in the Y-direction.

[0059]

Next, in S254, the process processing every each pixel data is performed in the process processor 8 as mentioned above, and the result is stored in the frame memory K (in this case, the frame memory 1) in sequence. Then, when it is detected in S255 that all of the pixel data in one frame is stored in the frame memory K, the routine proceeds to the next step S256.

[0060]

In S256, it is discriminated whether the value of the frame memory setting parameter K is equal to 'N' (in this case, N=4). When the value is not equal to 'N,' the value of K is counted up by 1 in S257. Then, it is again discriminated whether the

accumulation of the next one frame is completed in S251. When it is detected the completion of the image accumulation, in S252 and S253, $\Delta X(2)$ and $\Delta Y(2)$ are set to a value that causes shifting of a half pixel pitch in the slant direction of the original image, respectively. Thereafter, the operations in S252 to S257 are repeated. In cases where the steps S252 and S253 are executed again, $\Delta X(3)$ is set to a value that causes shifting of one pixel pitch in the horizontal direction against the aforementioned second image pixel shifting, and $\Delta Y(3)$ is set to '0.'

[0061]

As mentioned above, by repeating the processing until the value of K becomes 'N' (in this case, N=4) in S256, four frame images which are shifted by a prescribed image pixel pitch in the X-direction and Y-direction every each frame, which are shown in Fig. 7, can be obtained.

[0062]

Hereinafter, a movement of the correction optical portion 4 in accordance with the aforementioned pixel shift photographing is shown in Fig. 8, and will be explained in detail. In Fig. 8, the actual movement of the correction optical portion 4 in the X-direction and Y-direction is shown against the time axis t.

[0063]

The hand-blur correcting operation is executed before the actual photographing operation. Therefore, when the time t shown in Fig. 8 is before the actual photographing term, the correction optical portion 4 is moving in the X-direction and Y-direction

depending on the output from the blur-sensor 17 (two blur-sensors are actually provided in order to detect each blurring in the X-direction and Y-direction) as shown in Fig. 8.

[0064]

After the first photographing (after the completion of the image accumulation), the correction optical portion 4 is shift-moved in parallel by $\Delta X(1)$ only in the X-direction. In this state, while continuously executing the hand-blur correction, the second photographing is performed. After the second photographing, the correction optical portion 4 is shift-moved by $\Delta X(2)$ and $\Delta Y(2)$ in the X-direction and Y-direction, respectively, and then the third photographing is performed. After the third photographing, the correction optical portion 4 is shift-moved by $\Delta X(3)$ only in the X-direction, and the fourth photographing is performed. Thereafter, the pixel shift photographing is completed by restoring all of the shifting.

[0065]

Returning to Fig. 5, as mentioned above, four frames of pixel shift images are obtained until S258. Then, in S258 and thereafter, the operation for converting the high density image data actually obtained by the pixel shifting into the actual RGB information is performed. First, in S258, the value of parameter K for specifying the frame memory which stores the image data obtained by the first pixel shift photographing is set to '1.' Subsequently, the contents of this frame memory is transferred to the image composing portion 9 (S259), and only the judgment on whether the transferring

of one frame is completed in S260 without performing any interpolation operation for the lacking RGB information of each pixel is performed, which is different from the aforementioned 'photographing/storing mode 1.' When it is detected that the transferring of one frame is completed in S260, the routine proceeds to S261. Then, in order to detect that the transferring of all of the photographed image data is completed, it is discriminated whether the value of K is equal to 'N' (in this case, N=4). When the transferring of all of the photographing image data is not completed, the value of K is counted up by 1, and the routine proceeds to S259 to start the transferring of the content of the following frame memory.

[0066]

When the transferring of all of the photographed data has been finally completed, the value of K becomes equal to 'N' in S261 and the routine proceeds to S263 to actually compose all of the photographed image data.

[0067]

This image composition will be explained with reference to Fig. 9. The left portion of Fig. 9 shows the spatially re-arranged array of each pixel data to be obtained by four-time pixel shifting. This image data array has spatial frequency horizontally and vertically approximately twice the spatial frequency of the image data of the image pickup element having the original Bayer arrangement shown in Fig. 2. In order to obtain each of RGB information horizontally and vertically twice the information of

the aforementioned image data array, it is required to execute the calculation using the interpolation filter having a matrix shown in the middle portion of Fig. 9.

[0068]

As for the G component, as shown in the middle upper portion of Fig. 9, 3 x 3 matrix similar to a conventional matrix is enough for the G component. For example, in making G signal at the position of the pixel 'a' in the pixel array, the G signal can be obtained by multiplying the coefficient of the interpolation filter for G by each intensity data of the pixel 'a' and its peripheral eight pixels surrounded by the dotted line. In this case, the coefficient against the G output at the position of the pixel 'a' is '1,' and the coefficient of upper, lower, left and right side thereof is '0.25.' However, since the G output at this position is '0,' the G data is actually decided only by the output value at the position of this pixel 'a.' On the other hand, in creating the G signal at the position of the pixel 'b' in the pixel array, the G signal can be obtained by multiplying the coefficient of the interpolation filter for G by each intensity data of the pixel 'b' and its peripheral eight pixels surrounded by the dotted line. However, in this case, since there is no G signal at the position of the pixel 'b,' the G data at this position is determined by using the mean value of the upper, lower, left and right G signals.

[0069]

Next, as for the R/B component, it is required to perform more complex processing as compared with the processing of G

component. As will be understood from the pixel array shown in the left portion of Fig. 9, the output value of the R/B component can be interpolated in the horizontal direction from the adjacent pixel data. However, as for the interpolation in the vertical direction, it is required to use pixel data at a position apart from it. Accordingly, the 5 x 5 matrix shown in the lower center of Fig. 9 is used. In this matrix, it is characterized that the vertical coefficient array having a center at the middle portion is not the same as the horizontal coefficient array. By performing the aforementioned operations to each of RGB components every pixel array, the RGB information to all pixel arrays as shown in the right portion of Fig. 9 can be obtained finally.

[0070]

After the composition of the pixel shift image of four frames is completed in the image composing portion 9, all the data is transferred to the work memory 13 in Step S264 in order to compress/store the composed image data. Subsequently, in S265, it is set to the memory control circuit 10 so as to execute an irreversible compression as a compression type..

[0071]

In this irreversible compression, a compressed image cannot be restored to exactly the same image as the original one. Among irreversible compression methods, the so-called DCT (Discrete Cosine Transform) conversion method is known. According to this method, in the JPEG type defining the compression standard of a still image, each image is divided into blocks each consisting of

8 x 8 pixels and then converted into two-dimensional frequency data. By performing a compression of an image by this method, it becomes possible to considerably decrease the data amount of the original image.

[0072]

The operation of the DCT is schematically shown in Fig. 10. The operation will be detailed below. As mentioned above, in the DCT, the whole frame is divided into blocks each normally having 8 x 8 pixels, and each block is subjected to the same conversion processing. The left block of Fig. 10 shows an example of the pixel signal level of the aforementioned 8 x 8 pixel block. The upper center block of the Fig. 10 shows each pixel signal level converted into each coefficient.

[0073]

[Formula 1]

[0074]

The coefficient of the upper left portion in the upper central block of Fig. 10 shows the DC component contained in an image. The remaining coefficients toward the right lower portion show the degree of high-frequency components contained in the image. Next, each of these coefficients is quantized by each corresponding value in the quantization table shown in the lower central block of Fig. 10, whereby the coefficient block shown in the right block of Fig. 10 is obtained. Then, finally, the quantized coefficient block is encoded by, for example, a Huffman-coding method.

[0075]

The aforementioned quantization means to convert the predetermined coefficient S of a block into a quotient obtained by dividing the coefficient by the data at the corresponding portion of the quantization table. For example, in the upper center coefficient block of Fig. 10, the value of S00 which is i, j= 0 is '260.' The result that the aforementioned value is quantized by the corresponding quantization table data '16' shown in the lower center block of Fig. 10 becomes '16' which appears in the upper left corner of the right coefficient block of Fig. 10. Therefore, the compression degree of a picked-up image can be arbitrarily set up by changing the value of the quantization table data shown in the lower central block of Fig. 10 against the result converted into the frequency data shown in the upper central block of Fig. 10.

[0076]

Therefore, in this embodiment, in Step S266, irreversible compression, such as the aforementioned DCT method, of a composite image after the aforementioned image shifting is executed every each block having 8 x 8 pixels. In Step S267, the image data to which the irreversible compression was executed is encoded by Huffman coding method, etc. in the same manner as in the aforementioned 'photographing/storing mode 1.' This encoded image data is stored in the external memory 14 one by one in Step S268. In Step S269, it is detected that the compression of all images (all blocks) and the storing thereof into the external memory are completed, and then the processing of 'photographing/storing

mode 2′ is terminated.

[0077]

In this embodiment, an example in which a high-definition image obtained by image-shifting photographing is subjected to irreversible compression processing and then stored in a memory or the like was explained. Although it seems that it is contradictory to adopt such a compression method which causes deterioration of image quality to a high-definition image, normally, the deterioration of image quality at the time of compressing by a DCT conversion or the like is very slight unless compressibility is increased extremely. Therefore, by composing a very high-definition image by image-shifting photographing to set up a suitable compressibility, it is possible to maintain highly-definition of the image.

[0078]

In the explanation of this embodiment, although four frames are photographed by the image shifting and then composed. However, the number of frames photographed by the image-shifting is not limited to this example.

[0079]

As explained above, in this embodiment, according to the photographing mode set by a user, the camera itself determines automatically whether to perform normal photographing or image-shifting photographing, photographing with the image quality required by the user is performed. Moreover, since the camera side automatically determines the optimal compression method when the

photographed image is stored in a memory, it is not necessary for a user to judge compressibility or the like. Therefore, suitable photographing can be attained by the user who does not have full knowledge of a digital image, etc.

[0080]

<Second embodiment> Hereinafter, a second embodiment according to the present invention will be explained with reference to the flowcharts shown in Figs. 11-14. Since the structure of the digital still camera of the second embodiment is the same as that of the camera shown in Fig. 1, the explanation will be omitted by allotting the same reference numeral.

[0081]

In the aforementioned first embodiment, an example in which the photographing method and the compression method of the picked-up image data are determined according to the photographing mode set by the user was explained. In the second embodiment, it is characterized that the photographing method and the compression method of the picked-up image data are determined according to the blur state at the time of actual photographing.

[0082]

Fig. 11 is a flowchart showing the photographing sequence of the camera according to the second embodiment. It is needless to say that this photographing sequence is controlled by the general control portion 1 of the camera.

[0083]

The photographing preparation operation of the camera shown

in S300-S307 will be omitted since the operation is completely the same as that of S100-S107 shown in Fig. 3 of the aforementioned first embodiment.

[0084]

When the release SW is turned on and photographing preparation is completed, in S307, it is discriminated whether the photographing mode is 'sport mode' or 'portrait mode.' When the photographing mode is 'sport mode,' 'normal photographing mode' as a mode for performing actual photographing is set in S308. The aforementioned normal photographing denotes one-time-exposure photographing. Then, the routine proceeds to S309 to discriminate whether 'continuation-photographing mode' is set. The aforementioned 'continuation-photographing mode' denotes a mode in which a plurality of images are taken continuously by one release operation of a camera and the result is stored in a memory or the like. When the 'continuation-photographing mode' is not set in S309, the routine proceeds to S310. In S310, actual photographing at the 'photographing/storing mode 1' and storing the photographed data into the frame memory portion 11 are performed. The explanation of the operation of this 'photographing/storing mode 1' will be omitted since it is the same as that of the processing shown in the flowchart of Fig. 4 according to the aforementioned first embodiment. In this mode, such a standard photographing/storing operation that photographed image is converted into a reversible file format and the converted image is stored in a memory or the like is performed.

[0085]

On the other hand, when the 'continuation-photographing mode' is set in S309, the routine proceeds to S311 to execute a 'photographing/storing mode 3.' In this 'photographing/storing mode 3,' the amount of the photographed data to be stored is minimized by performing a reversible compression of only the first frame and an irreversible compression of the remaining frames photographed by continuation photographing. The detail explanation will be made later.

[0086]

On the other hand, when the photographing mode of the camera is set to the 'portrait mode' in S307, the 'image-shifting photographing mode' is set as the mode for the actual photographing in S312. This image-shifting photographing is the same as that of the first embodiment mentioned above. Therefore, the explanation will be omitted.

[0087]

Subsequently, in Step S313, it is discriminated whether the present blur amount is large. In the blur amount discrimination method, it is discriminated by detecting the output of the blur sensor 17 or directly detecting the blur on the image pickup surface based on the correlation of images every frame of the image pickup portion 6. Although it is possible to detect the correct blur remain amount after the actual blur correction by the compensation optical portion 4 by performing the blur discrimination based on the image correlation for every frame, the explanation about this

discrimination method will be omitted here.

[0088]

When the blur amount is smaller than the predetermined level in S313, the routine proceeds to S314 to execute the 'photographing/storing mode 2.' The explanation of this 'photographing/storing mode 2' will be omitted since it is the same as that of the first embodiment mentioned above. In this mode, basically, a high definition photographed image can be obtained by a plurality of image-shifting photographing and saved in irreversibly compressed manner.

[0089]

When the blur amount is larger than the predetermined level in S313, it is not appropriate to perform the 'photographing/storing mode 2.'

[0090]

In the image-shifting photographing, image data of a plurality of frames is required since the spatial position of the image pickup means is shifted serially. As a result, the photographing time is extended, which causes the image to be easily influenced by blur because of the following reasons. Namely, when the shifted amount due to the blur becomes larger rather than the shifted amount shifted by one or half pixel due to the image shifting, the relation of the spatial array of each photographed image collapses at the time of composing the images, which may deteriorate the image quality.

[0091]

Therefore, in this case, the routine proceeds to S315 to perform the 'photographing/storing mode 4.' In this 'photographing/storing mode 4,' even if the 'image-shifting photographing mode' is set, an improvement in quality of image due to the image shifting cannot be expected. Accordingly, standard photographing and standard storing such as 'photographing/storing mode 1' are performed, which will be detailed later.

[0092]

Hereinafter, each operation of the aforementioned 'photographing/storing-mode 3' and 'photographing/storing mode 4' will be explained in detail.

[0093]

The operation of the 'photographing/storing mode 3' when a 'continuation-photographing mode' is set will be explained with reference to the flowchart of Figs. 12 and 13.

[0094]

In S350, '1' is substituted for the parameter K for selecting a frame memory which stores the output from the process processing portion 8 temporarily, and a frame memory 1 is designated. Subsequently, in S351, it is discriminated whether the accumulation operation of the image data in the image pickup portion 6 is completed, and the routine waits here until the accumulation is completed. As explained in the first embodiment, when the accumulation operation for a predetermined time is completed in cases where the image pickup portion 6 is constituted by CCDs or the like, the electric charge generated by the photoelectric-

conversion operation is transmitted to a transfer portion immediately. Therefore, even if it is in the midst of reading out the generated electric charge successively, the next electric charge accumulation operation is performed.

[0095]

Therefore, in the following step S352, the result of the performed process processing for every pixel data as mentioned above is stored in the frame memory K (frame memory 1 in this case) sequentially. When it is detected that all of the pixel data in one frame are stored in the frame memory K in S353, the routine proceeds to the following step S354.

[0096]

In Step S354, in order to discriminate whether the photographing of the predetermined times is completed in the 'continuation-photographing mode,' it is discriminated whether the value of the parameter K which designates a frame memory is equal to N. Of course, this N is set by the user beforehand as the photographing number of sheets to be continuously photographed. Here, when the value of K has not reached N yet, the routine proceeds to S355 to count up the value of K by 1 and again proceeds to S351 to discriminate whether the next photographing (image accumulation) is completed. Then, after the completion of photographing of the predetermined number of sheets, the value of parameter K becomes equal to N in S354, and then the processing proceeds to S356.

[0097]

In S356, in order to designate a frame memory, '1' is set to the parameter K. Subsequently, in S357, the contents of this frame memory K (frame memory 1) are transferred to the image composition portion 9. Then, as explained in the first embodiment, an interpolation operation to the lacking RGB information for every pixel is performed, and the result is transferred to the work memory 13 in S358. This operation is continuously performed by one frame. When it is detected in S359 that the processing for one frame is completed, the routine proceeds to S360.

[0098]

In S360, an execution of a reversible compression as a method of compressing an actual image is set to the memory control portion 10. As a concrete method of this reversible compression, the DPCM method in the 'photographing/storing mode 1' shown in the first embodiment mentioned above is performed. The following steps S361 to S364 is the same as that of the steps S208 to S211 of Fig. 4 showing the operation of 'photographing/storing mode 1.' Therefore, the explanation will be omitted. The first frame photographed by the continuation-photographing mode is reversibly compressed in accordance with the aforementioned processing and then saved.

[0099]

When the store of all blocks of the picked-up image of the first frame is completed in S364, the routine proceeds to S365. In S365, '2' is allotted to the parameter K in order to set the subsequent frame memory. Subsequently, in S366, the contents of

this frame memory K (frame memory 2) are transferred to the image composition portion 9, and the interpolation operation is executed here. Thereafter, it is transferred to the work memory 13 in S367. This operation is continuously performed by one frame. When it is detected that the processing for one frame is completed in S368, the routine proceeds to S369.

[0100]

In S369, the irreversible compression is set to the memory control portion 10 as a method of compressing an actual image. As a concrete method of this irreversible compression, the DCT conversion as explained in the 'photographing/storing mode 2' of the first embodiment is performed. Therefore, in S370, after dividing the picked-up image into blocks each having 8 x 8 pixel, the DCT conversion is performed. Subsequently, after performing coding processing of a Huffman-coding or the like in S371, this coded data is stored in the external memory 14 in S372. Furthermore, in S373, it is discriminated whether the compression and storing of all blocks are completed. When the compressing and storing of all blocks are not completed, the routine returns to S370 again, and the aforementioned operation is repeated. However, when the storing of all blocks to the external memory 14 is completed, the routine proceeds to S374.

[0101]

In S374, in order to discriminate whether the compressing and the storing of all of the picked-up images are completed, it is checked whether the value of the set-parameter K of the frame

memory reached the predetermined value N. When it is not completed yet, the value of K is counted up by 1 in S375. Thereafter, the routine returns to S366 again to repeat the compressing/storing operation to the subsequent picked-up image. Therefore, at the time of the completion of the compressing/storing operation to all of the picked-up images, the operation of the 'photographing/storing mode 3' is terminated.

[0102]

As explained above, in the 'photographing and the storing mode 3' of the second embodiment, the first frame among the continuously photographed frames is subjected to the reversible compression and the remaining frames are subjected to the irreversible compression. That is, the data compressing and storing which are specialized in the continuous photographing mode are performed.

[0103]

Subsequently, the operation in the 'photographing/storing mode 4' when the blur amount caused by the user is large will be explained with reference to the flowchart of Fig. 14.

[0104]

The operation shown in S400 to S407 is an operation for storing all the images obtained by image-shifting photographing into a frame memory. This operation is the same as the operation shown in S250 to S257 in the flowchart of Fig. 5 showing the 'photographing/storing mode 2' in the aforementioned first embodiment. Therefore, the explanation will be omitted.

[0105]

After the completion of photographing for the predetermined number of sheets by the image shifting, the value of parameter K becomes equal to N in S406, and the routine proceeds to S408.

[0106]

In S408, in order to designate a frame memory, '1' is set to the parameter K. Subsequently, in S409, the contents of this frame memory K (frame memory 1) is transferred to the image composition portion 9 to execute the interpolation operation which creates the RGB information for all pixels. The result is once transferred to the work memory 14 in S410. This operation is continuously performed by one frame, and the routine proceeds to S412 when it is detected that the processing for one frame is completed in S411.

[0107]

In S412, the reversible compression is set to the memory control portion 10 as a method of compressing an image. As a concrete method of this reversible compression, the DPCM method explained in the 'photographing/storing mode 1' of the first embodiment is performed. The steps of S413 to S416 are the same as the steps of S208 to S211 in the 'photographing/storing mode 1' shown in Fig. 4. Accordingly, the explanation will be omitted.

[0108]

When the storing of all blocks of the first frame of the picked-up image is completed in S416, the routine proceeds to S417, and it is discriminated whether the compression and storing of all

picked-up images are completed. When not completed, the routine proceeds to S418 to count up the value of the parameter K by '1.' Then, the routine proceeds to S409 again to perform the compression and storing for the subsequent picked-up images. That is, the photographed image data of the number of sheets which were took by image-shifting photographing is reversibly compressed and stored in the external memory 14 as it is.

[0109]

As explained above, in the second embodiment, even if the image-shifting photographing mode is automatically selected, the blur amount before photographing is large and image composition will not be performed in cases where high definition cannot be expected even if the image composition is executed as it is. Furthermore, the compression method is changed. That is, it is determined whether to store each frame data separately according to the blur amount or to store each data as one image data which composed each frame image.

[0110]

In the aforementioned explanation of the second embodiment, the blur amount is discriminated before photographing. However, this discrimination may be performed during the photographing. For example, the blur discrimination may be performed among the steps of S400 to S407 in Fig. 14 showing the 'photographing/storing mode 4.'

[0111]

Furthermore, in the aforementioned example, in cases where

the detected blur amount is large, it is explained that image composition will not be performed to a plurality of photographed frames even if the pixel shifting photographing mode is set. However, it is also possible not to perform the image-shifting photographing when the blur amount is large.

[0112]

As explained above, according to the second embodiment, when the user's hand-blur amount is large at the time of photographing by a camera, even if the image-shifting photographing mode is set, it is possible to suppress the influence of the image quality deterioration in the photographed image due to the blur by performing the composition of the plurality of images photographed by the image-shifting for each frame and automatically changing the storing method of the photographed image.

[0113]

< Third embodiment>

Hereinafter, a third embodiment according to the present invention will be explained with reference to the flowchart of Figs. 15 and 16. The structure of the digital still camera in the third embodiment is the same as that shown in Fig. 1. Accordingly, the explanation will be omitted by allotting the same reference numeral.

[0114]

In the first and second embodiments mentioned above, an example which determines the photographing method and the compression method of photographed image data based on the

photographing mode and the blur state was explained. In the third embodiment, it is characterized to determine the photographing method and the compression method of photographed image data depending on the memory empty situation storing the photographed image data.

[0115]

Fig. 15 is a flowchart showing a photographing sequence in the camera of the third embodiment. Needless to say, this photographing sequence is controlled by the general control portion 1 of the camera.

[0116]

As for the photographing preparation operation of the camera shown in S500 to S507, the photographing preparation operation is completely the same as that of S100 to S107 shown in Fig. 3 in the aforementioned first embodiment. Therefore, the explanation will be omitted.

[0117]

When the release SW is turned on and the photographing preparation is completed, in S507, it is discriminated whether the photographing mode is the 'sport mode' or the 'portrait mode.' When it is the 'sport mode', the usual 'normal photographing mode' will be set as the mode at the time of performing actual photographing in S508. The aforementioned normal photographing denotes a photographing by one-time exposure. Then, the routine proceeds to S509, and it is discriminated whether the 'continuation photographing mode' is set. Here, the aforementioned

'continuation photographing mode' denotes a mode in which a plurality of images are photographed continuously by one release operation of the camera and the result is stored in a memory or the like. When the 'continuation-photographing mode' is not set, the routine proceeds to S510 to discriminate whether the memory capacity of the external memory 14 is enough.

[0118]

Hereinafter, the judging method of the memory capacity of the external memory 14 will be explained in detail with reference to Fig. 17. Fig. 17 shows the memory operating condition at the time of storing the photographed image in the external memory 14. In the third embodiment, the photographed result is stored from the memory of smaller address one by one such that the first photographing result is stored in the address 0 and the second photographing result is stored in the address 1. Since the information amount of the photographing frame differs every photographing, the address value does not necessarily coincide with the photographing number of the image. Therefore, the user can find the remaining memory capacity from the final address (n+1) of the memory itself and the current address (m) indicated by the pointer. In order to discriminate whether the remaining capacity is enough for the subsequent processing, it is necessary to set the threshold beforehand. Of course, this threshold may be changed by the user.

[0119]

When the remaining capacity of the external memory 14 is enough, the routine proceeds to S511 to perform the actual

photographing at the 'photographing/storing mode 1' and the storing the photographed data into the frame memory portion 11. The operation of this 'photographing/storing mode 1' is the same as that of the processing shown in the flowchart of Fig. 4 in the first embodiment mentioned above. Therefore, the explanation will be omitted. In this mode, fundamentally, a standard photographing/storing of photographed image is executed, such as the photographed image is converted into the file format which can be reversibly compressed and the converted image is stored in a memory or the like.

[0120]

On the other hand, in cases where the remaining capacity is not enough in S510, the routine proceeds to S520 compulsorily to perform the 'photographing/recording mode 5' here. The operation of this 'photographing/storing mode 5' will be detailed later. In short, the mode is a mode in which only one frame is photographed (hereinafter, single photographing) and the photographed image is compressed and stored with high compressibility so that the photographed image can be stored by small memory capacity.

[0121]

On the other hand, when the 'continuation-photographing mode' is selected in S509, the routine proceeds to S512 to discriminate whether the memory capacity of the external memory 14 is enough. When the remaining capacity is enough, the routine proceeds to S513 to execute the 'photographing/storing mode 3.' Although the explanation of the 'photographing/storing mode 3' will

be omitted since this 'photographing/storing mode 3' is the same as that of the second embodiment mentioned above, only 1 frame photographed is subjected to the reversible compression and the remaining to the irreversible compression.

[0122]

When the memory capacity of the external memory 14 is below the predetermined level in S512, the routine proceeds to S520 to execute the 'photographing/storing mode 5.' That is, in the third embodiment, even if the 'continuation-photographing mode' is set, when the remaining capacity of the external memory 13 is small, a single photographing is performed compulsorily. As the compression of the photographed image, a compression method with high compressibility such as irreversible compression is selected.

[0123]

Subsequently, the following explanation is directed to the case where the 'photographing mode' of the camera is set to the 'portrait mode' in S507. When the 'portrait mode' is selected, the 'image-shifting photographing mode' is set in S514. Since this 'image-shifting photographing mode' is the same as that of the first example mentioned above, the explanation will be omitted.

[0124]

Subsequently, it is discriminated whether the blur amount at this time is large in S515. This judgment processing is the same as that of the second embodiment mentioned above.

[0125]

When the blur amount is smaller than the predetermined level,

the routine proceeds to S516 to discriminate whether the memory capacity of the external memory 14 is enough. When the memory capacity is enough, the routine proceeds to S517 to execute the 'photographing/storing mode 2.' This 'photographing/storing mode 2' is the same as that of the first embodiment. In this mode, a plurality of photographed images are composed by the image-shifting photographing and the irreversible compression is performed to this composite image.

[0126]

On the other hand, when the memory capacity of the external memory 14 is smaller than the predetermined level in S516, the routine proceeds to S520 to execute the 'photographing/storing mode 5.' That is, even if the 'image-shifting photographing mode' is selected, when the memory capacity is small, the amount of the memory is saved by performing a single photographing compulsorily and further performing the irreversible compression.

[0127]

Furthermore, when the blur amount is larger than the predetermined level in S515, in the next S518, it is discriminated whether the memory capacity of the external memory 14 is enough. When it is enough, the 'photographing/storing mode 4' is performed in S519. Since the operation of this 'photographing/storing mode 4' is the same as that of the flowchart of Fig. 14 explained in the second embodiment, the explanation will be omitted.

[0128]

Moreover, when the memory capacity is smaller than the

predetermined level in S518, the routine proceeds to S520 and to execute the 'photographing/storing mode 5.' That is, even in cases where the 'image-shifting photographing mode' is selected, a single photographing is performed compulsorily and the irreversible compression is performed.

[0129]

As mentioned above, in the third embodiment, when the remaining capacity of the external memory 14 which stores the photographed image data is not enough, the 'photographing/storing mode 5' is performed. Hereinafter, the operation of the 'photographing/storing mode 5' will be explained in detail with reference to the flowchart of Fig. 16.

[0130]

In Fig. 16, the operation of S550 to S556 is the same as that of S200 to S206 of the 'photographing/storing mode 1' shown in Fig. 4 in the first embodiment. That is, all image signals are stored in the frame memory K after one photographing operation, and the contents of this frame memory K (frame memory 1) are transferred to the image composition portion 9, and the interpolation operation of the RGB information is performed and then transferred to the work memory 13.

[0131]

Subsequently, in S557, the irreversible compression is set to the memory control portion 10 as a method of compressing an actual image. The DCT conversion explained in the 'photographing/storing mode 2' of the first embodiment as a concrete method of this

irreversible compression is performed. Since the subsequent steps S558 to S561 are the same as those of S265 to S269 shown in Fig. 5, the explanation will be omitted.

[0132]

As mentioned above, in the 'photographing/storing mode 5,' since the remaining external memory capacity is small, a single photographing is performed compulsorily, and furthermore the data compression/storing by the high irreversible compression with high compressibility are performed.

[0133]

As explained above, according to the third embodiment, even if any photographing mode of a camera is set, when the remaining capacity of the external memory 14 is small, the single photographing is performed compulsorily, and the compression with high compressibility is performed. This further decreases the amount of photographed image data to be stored. Therefore, a user can perform the maximum photographing without caring about the remaining capacity of the memory.

[0134]

<Other Embodiments>

The present invention may be applied to an apparatus comprising a plurality of devices (a host computer, an interface device, an image taking apparatus, a printer, etc.), or an apparatus consisting of one device (a digital still camera, a digital video camera, etc.).

[0135]

Furthermore, needless to say that the object of the present invention can be attained by supplying the storing medium which recorded the program code of software for realizing the function of the aforementioned embodiment to a system or an apparatus, and by reading out and executing the program code stored in the storing medium by the system or the computer (or CPU, MPU).

[0136]

In this case, the program code itself read from the storing medium realizes the function of the aforementioned embodiment. The storing medium storing the program code constitutes the present invention.

[0137]

As a storing medium for supplying the program code, a floppy disk, a hard disk, an optical disk, and an magneto-optic-disk, a CD-ROM, a CD-R, a magnetic tape, a non-volatile memory card, a ROM, etc., can be used.

[0138]

Furthermore, needless to say, also included are the case where the function of the aforementioned embodiment is realized by executing the program code which the computer read out and the case where an OS (operating system) which is working on a computer performs a part or all of the processing based on directions of the program code, and the function of the aforementioned embodiment is realized by the processing.

[0139]

Furthermore, also included are the case where after the

program code read out from the storing medium was written in the memory with which the expansion unit connected to the expansion board inserted in the computer or the computer is equipped, a part or all of the actual processing are performed by a CPU with which an expansion board and expansion unit are equipped based on the directions of the program code, and the function of the aforementioned embodiment is realized by the processing.

[0140]

[Effect of the invention]

As explained above, according to the present invention, it becomes possible to perform the optimal photographing according to the subject and to store the photographed image data without complicated work by automatically changing the photographing method according to the photographing mode set to the image taking apparatus and the compression method of photographed image data.

[0141]

Furthermore, the influence by the operating state of the photographed image can be suppressed by changing appropriately the photographing method and the compression method of photographed image data according to the operating state (blurring, etc.) at the time of photographing of the image taking apparatus.

[0142]

Furthermore, the maximum photographing with the limited memory capacity can be attained by changing appropriately the photographing method and the compression method of photographed image data according to the memory capacity storing the

photographed image data.

[0143]

Thus, in order to determine the suitable photographing method and the photographing data storing method at the image taking apparatus side automatically, even if a user is not skilled in photographing operation, photographing can be performed comfortably.

[0144]

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1]

Fig.1 is a block diagram showing the structure of the digital still camera according to one embodiment of the present invention.

[Fig. 2]

Fig.2 is a figure explaining the interpolation method for the color composition in this embodiment.

[Fig. 3]

Fig. 3 is a flowchart which shows the camera sequence in this embodiment.

[Fig. 4]

Fig. 4 is a flowchart which shows the operation of the photographing/storing mode 1 in this embodiment.

[Fig. 5]

Fig. 5 is a flowchart which shows the operation of the photographing/storing mode 2 in this embodiment.

[Fig. 6]

Fig. 6 is a figure explaining the reversible compression

method of the photographed image in this embodiment.

[Fig. 7]

Fig. 7 is a figure explaining the principle of the image-shifting photographing in this embodiment.

[Fig. 8]

Fig. 8 is a figure explaining a motion of the compensation optical system accompanying the image-shifting photographing in this embodiment.

[Fig. 9]

Fig. 9 is a figure explaining the color composition at the time of performing image-shifting photographing in this embodiment.

[Fig. 10]

Fig. 10 is a figure explaining the irreversible compression method of the photographed image in this embodiment.

[Fig. 11]

Fig. 11 is a flowchart which shows the camera sequence according to the second embodiment of the present invention.

[Fig. 12]

Fig. 12 is the flowchart which shows the operation of the photographing/storing mode 3 in the second embodiment.

[Fig. 13]

Fig. 13 is the flowchart which shows the operation of the photographing/storing mode 3 in the second embodiment.

[Fig. 14]

Fig. 14 is the flowchart which shows the operation of the

photographing/storing mode 4 in the second embodiment.

[Fig. 15]

Fig. 15 is the flowchart which shows the camera sequence in the third embodiment according to the present invention.

[Fig. 16]

Fig. 16 is the flowchart which shows the operation of the photographing/storing mode 5 in the third embodiment.

[Fig. 17]

Fig. 17 is a figure explaining the busy condition of the memory in the third embodiment.

[Fig. 18]

Fig. 18 is the block diagram showing a structure of a conventional digital still camera.

[Description of reference numerals]

1 General control portion

2 Photographing mode setting portion

4 Compensation optical system

6 Image pickup portions

8 Process processing portion

9 Image composition portion

10 Memory control portion

11 Frame memory

14 External memory

17 Blur sensor

[FIG. 1]

1 GENERAL CONTROL PORTION

2 PHOTOGRAPHING MODE SETTING PORTION

5 LENS DRIVING PORTION

6 IMAGE PICKUP PORTION

7 A/D CONVERTER

8 PROCESS PROCESSING PORTION

9 IMAGE COMPOSING PORTION

10 MEMORY CONTROL PORTION

11 FRAME MEMORY 1.........N

13 WORK MEMORY

14 EXTERNAL MEMORY

15 VIDEO MEMORY

16 MONITOR DISPLAY PORTION

17 BLUR SENSOR

18 CAMERA OPERATION SWITCH

[FIG. 2]

<PIXEL ARRAY OF IMAGE PICKUP ELEMENT>

GREEN

RED

BLUE

INTERPOLATION FILTER FOR G

INTERPOLATION FILTER FOR R/B

<PIXEL ARRAY AFTER INTERPOLATION PROCESSING>

[FIG. 3]

CAMERA SEQUENCE

S100 MAIN SW=ON?

S101 SUPPLY POWER TO ALL CIRCUITS

S102 ACTIVATION OF BLUR SENSOR

S103 START OF BLUR CORRECTION

S104 START OF IMAGE SIGNAL PROCESSING

S105 START OF MONITOR DISPLAY

S106 RELEASE SW=ON?

S107 PHOTOGRAPHING MODE DISCRIMINATION?

SPORT MODE

S108 NORMAL PHOTOGRAPHING MODE SETTING

S109 PHOTOGRAPHING/STORING MODE 1

PORTRAIT MODE

S110 IMAGE SHIFTING PHOTOGRAPHING MODE SETTING

S111 PHOTOGRAPHING/STORING MODE 2

S112 RELEASE SW=OFF?

TO START

[FIG. 4]

PHOTOGRAPHING/STORING MODE 1

S200 FRAME MEMORY SETTING K←1

S201 COMPLETION OF IMAGE ACCUMULATION?

S202 RESULTS OF PROCESS PROCESSING →FRAME MEMORY K

S203 COMPLETION OF ONE FRAME STORING?

S204 FRAME MEMORY DATA → IMAGE COMPOSING CIRCUIT

S205 IMAGE COMPOSING CIRCUIT → WORK MEMORY

S206 COMPLETION OF ONE FRAME TRANSFERRING?

S207 COMPRESSION TYPE → REVERSIBLE COMPRESSION

S208 EXECUTION OF REVERSIBLE COMPRESSION EVERY EACH BLOCK

S209 CODING

S210 CODE DATA → EXTERNAL MEMORY

S211 COMPLETION OF ALL BLOCKS?

END

[FIG. 5]

PHOTOGRAPHING/STORING MODE 2

S250 FRAME MEMORY SETTING K ← 1

S251 COMPLETION OF IMAGE ACCUMULATION

S252 X-DIRECTION OF SHIFTING FOR A PREDETERMINED AMOUNT ← $\triangle$X(K)

S253 Y-DIRECTION OF SHIFTING FOR A PREDETERMINED AMOUNT ← $\triangle$Y(K)

S254 RESULT OF PROCESS PROCESSING → FRAME MEMORY K

S255 COMPLETION OF 1 FRAME MEMORY STORING?

S256 K=N?

S257 K←K+1

S258 FRAME MEMORY SETTING K←1

S259 FRAME MEMORY DATA → IMAGE COMPOSING CIRCUIT

S260 COMPLETION OF 1 FRAME TRANSFERRING

S261 K=N?

S262 K←K+1

S263 EXECUTION OF IMAGE COMPOSITION

S264 IMAGE COMPOSING CIRCUIT → WORK MEMORY

S265 COMPRESSION TYPE → IRREVERSIBLE COMPRESSION

S266 EXECUTION OF IRREVERSIBLE COMPRESSION EACH BLOCK

S267 CODING

S268 CODE DATA → EXTERNAL MEMORY

S269 COMPLETION OF ALL BLOCKS?

END

[FIG. 6]

ORIGINAL IMAGE

↓

PIXEL NUMBER

ORIGINAL IMAGE

CODE DATA

CODE DATA ARRAY

[FIG. 7]

<ORIGINAL IMAGE> GREEN

RED

BLUE

X-DIRECTION

<1-TIME SHIFTING>

XY-SLANT DIRECTION

<2-TIME SHIFTING>

XY-SLANT DIRECTION

<3-TIME SHIFTING>

[FIG. 8]

X-DIRECTION EFFECTIVE PHOTOGRAPHING PERIOD

Y-DIRECTION

IMAGE ACCUMULATION TIMING 1ST PHOTOGRAPHING, 2ND, 3RD, 4TH

IMAGE READING TIMING

[FIG. 9]

<PIXEL ARRAY OF IMAGE PICKUP ELEMENT>

GREEN

RED

BLUE

INTERPOLATION FILTER FOR G

INTERPOLATION FILTER FOR R/B

<PIXEL ARRAY AFTER INTERPOLATION PROCESSING>

[FIG. 10]

ORIGINAL IMAGE 8X8 PIXEL BLOCK

COEFFICIENT AFTER DCT CONVERSION

QUANTIZATION TABLE DATA

COEFFICIENT AFTER QUANTIZATION

CODING

[FIG. 11]

CAMERA SEQUENCE

S300 MAIN SW=ON?

S301 SUPPLY POWER TO ALL CIRCUITS

S302 ACTIVATION OF BLUR SENSOR

S303 START OF BLUR CORRECTION

S304 START OF IMAGE SIGNAL PROCESSING

S305 START OF MONITOR DISPLAY

S306 RELEASE SW=ON?

S307 PHOTOGRAPHING MODE DISCRIMINATION?

SPORT MODE

S308 NORMAL PHOTOGRAPHING MODE SETTING

S309 CONTINUATION-PHOTOGRAPHING MODE?

S310 PHOTOGRAPHING/STORING MODE 1

S311 PHOTOGRAPHING/STORING MODE 3

PORTRAIT MODE

S312 PIXEL SHIFTING PHOTOGRAPHING MODE SETTING

S313 IS BLUR AMOUNT LARGE?

S314 PHOTOGRAPHING/STORING MODE 2

S315 PHOTOGRAPHING/STORING MODE 4

S316 RELEASE SW=OFF?

TO START

[FIG. 12]

PHOTOGRAPHING/STORING MODE 3

S350 FRAME MEMORY SETTING K←1

S351 COMPLETION OF IMAGE ACCUMULATION?

S352 RESULTS OF PROCESS PROCESSING → FRAME MEMORY K

S353 COMPLETION OF ONE FRAME STORING?

S354 K=N?

S355 K←K+1

S356 FRAME MEMORY SETTING K←1

S357 FRAME MEMORY DATA → IMAGE COMPOSING CIRCUIT

S358 IMAGE COMPOSING CIRCUIT → WORK MEMORY

S359 COMPLETION OF ONE FRAME TRANSFERRING?

S360 COMPRESSION TYPE → REVERSIBLE COMPRESSION

S361 EXECUTION OF REVERSIBLE COMPRESSION EACH BLOCK

S362 CODING

S363 CODE DATA → EXTERNAL MEMORY

S364 COMPLETION OF ALL BLOCKS?

[FIG. 13]

S365 FRAME MEMORY SETTING K←2

S366 FRAME MEMORY DATA → IMAGE COMPOSING CIRCUIT

S367 IMAGE COMPOSING CIRCUIT → WORK MEMORY

S368 COMPLETION OF ONE FRAME TRANSFERRING?

S369 COMPRESSION TYPE → IRREVERSIBLE COMPRESSION

S370 EXECUTION OF IRREVERSIBLE COMPRESSION EACH BLOCK

S371 CODING

S372 CODE DATA → EXTERNAL MEMORY

S373 COMPLETION OF ALL BLOCKS?

S374 K=N?

END

S375 K←K+1

[FIG. 14]

PHOTOGRAPHING/STORING MODE 4

S400 FRAME MEMORY SETTING K ← 1

S401 COMPLETION OF IMAGE ACCUMULATION

S402 X-DIRECTION OF SHIFTING FOR A PREDETERMINED AMOUNT ← $\triangle X(K)$

S403 Y-DIRECTION OF SHIFTING FOR A PREDETERMINED AMOUNT ← $\triangle Y(K)$

S404 RESULT OF PROCESS PROCESSING → FRAME MEMORY K

S405 COMPLETION OF 1 FRAME MEMORY STORING?

S406 K=N?

S407 K←K+1

S408 FRAME MEMORY SETTING K←1

S409 FRAME MEMORY DATA → IMAGE COMPOSING CIRCUIT

S410 IMAGE COMPOSING CIRCUIT → WORK MEMORY

S411 COMPLETION OF 1 FRAME TRANSFERRING

S412 COMPRESSION TYPE → IRREVERSIBLE COMPRESSION

S413 EXECUTION OF IRREVERSIBLE COMPRESSION EACH BLOCK

S414 CODING

S415 CODE DATA → EXTERNAL MEMORY

S416 COMPLETION OF ALL BLOCKS?

S417 K=N?

S418 K←K+1

END

[FIG. 15]

CAMERA SEQUENCE

S500 MAIN SW=ON?

S501 SUPPLY POWER TO ALL CIRCUITS

S502 ACTIVATION OF BLUR SENSOR

S503 START OF BLUR CORRECTION

S504 START OF IMAGE SIGNAL PROCESSING

S505 START OF MONITOR DISPLAY

S506 RELEASE SW=ON?

S507 PHOTOGRAPHING MODE DISCRIMINATION?

SPORT MODE

S508 NORMAL PHOTOGRAPHING MODE SETTING

S509 CONTINUATION-PHOTOGRAPHING MODE?

S510 SMALL REMAINING MEMORY CAPACITY?

S511 PHOTOGRAPHING/STORING MODE 1

S521 SMALL REMAINING MEMORY CAPACITY?

S513 PHOTOGRAPHING/STORING MODE 3

PORTRAIT MODE

S514 PIXEL SHIFTING PHOTOGRAPHING MODE SETTING

S515 IS BLUR AMOUNT LARGE?

S516 SMALL REMAINING MEMORY CAPACITY?

S517 PHOTOGRAPHING/STORING MODE 2

S518 SMALL REMAINING MEMORY CAPACITY?

S519 PHOTOGRAPHING/STORING MODE 4

S520 PHOTOGRAPHING/STORING MODE 5

S521 RELEASE SW=OFF?

TO START

[FIG. 16]

PHOTOGRAPHING/STORING MODE 5

S550 FRAME MEMORY SETTING K←1

S551 COMPLETION OF IMAGE ACCUMULATION?

S552 RESULTS OF PROCESS PROCESSING → FRAME MEMORY K

S553 COMPLETION OF ONE FRAME STORING?

S554 FRAME DATA → IMAGE COMPOSING CIRCUIT

S555 IMAGE COMPOSING CIRCUIT → WORK MEMORY

S556 COMPLETION OF ONE FRAME TRANSFERRING?

S557 COMPRESSION TYPE → IRREVERSIBLE COMPRESSION

S558 EXECUTION OF IRREVERSIBLE COMPRESSION EACH BLOCK

S559 CODING

S560 CODE DATA → EXTERNAL MEMORY

S561 COMPLETION OF ALL BLOCKS?

END

[FIG. 17]

ADDRESS	DATA	
0	1^{ST} PHOTOGRAPHING	
1	2^{ND} PHOTOGRAPHING	
3	3^{RD} PHOTOGRAPHING	
4	4^{TH} PHOTOGRAPHING	USED MEMORY REGION
5	5^{TH} PHOTOGRAPHING	
8	6^{TH} PHOTOGRAPHING	
9	7^{TH} PHOTOGRAPHING	
N	K^{TH} PHOTOGRAPHING	

CURRENT ADDRESS →

FINAL ADDRESS →

REMAINING MEMORY REGION

[FIG. 18]

80 GENERAL CONTROL PORTION

82 IMAGE PICKUP PORTION

83 A/D CONVERTER

84 PROCESS PROCESSING PORTION

85 MEMORY CONTROL PORTION

86 FRAME MEMORY

87 WORK MEMORY

88 EXTERNAL MEMORY

89 VIDEO MEMORY

90 MONITOR DISPLAY PORTION

91 CAMERA OPERATION SWITCH